Wilson Bull., 112(3), 2000, pp. 332–336

DIURNAL ROOST SITE CHARACTERISTICS OF NORTHERN SAW-WHET OWLS WINTERING AT ASSATEAGUE ISLAND, MARYLAND

JOHN B. CHURCHILL,[1,3] PETRA B. WOOD,[1] AND DAVID F. BRINKER[2]

ABSTRACT.—We characterized 30 diurnal roost sites of five radio-tagged Northern Saw-whet Owls (*Aegolius acadicus*) in the winters of 1996–1997 on Assateague Island, Maryland and found they preferred thick cover at roost sites. Roosts occurred most often in loblolly pine forest (*Pinus taeda*) and shrub swamps dominated by wax myrtle (*Myrica cerifera*). Vegetation was measured at paired roosts and random sites in similar habitats. Distance to nearest tree and average canopy height were significantly lower at roost sites than random sites. Numbers of stems larger than 2.5 cm diameter at breast height (dbh), stems smaller than 2.5 cm dbh, and roost tree dbh were larger at roost sites. Roost height, canopy cover, canopy height, shrub height, and ground cover differed significantly between pine and shrub swamp roosts, although cover above and below the roost site were similar. Higher densities of stems and shorter distances to the nearest tree at roost sites compared to random sites indicated that owls chose sites with dense cover, probably as protection from predators or weather. *Received 22 June 1999, accepted 18 March 2000.*

Several researchers have examined Northern Saw-whet Owl (*Aegolius acadicus*) diurnal roost site characteristics (Randle and Austing 1952; Hayward and Garton 1984; Grove 1985; Swengel and Swengel 1987, 1992) but not on a coastal barrier island. The coastal shrub community encompassing both pine forest and shrub swamp is a unique environment that may provide important wintering habitat for Northern Saw-whet Owls (Loos and Kerlinger 1993). The barrier island flora includes many plant species missing from inland habitats and the vegetation structure is very different from that of most inland plant communities in the eastern United States (Hill 1986).

Knowledge of diurnal roost site characteristics of Northern Saw-whet Owls may lead to a better understanding of their habitat requirements and help researchers evaluate the suitability of an area to support owls. The contrast between coastal and inland Northern Saw-whet Owl habitats and the lack of information on this issue prompted this study. Specifically, in an attempt to determine which variables are important to roosting owls, we compared vegetation characteristics at roost sites and random sites, and between pine forest and shrub swamps.

STUDY AREA AND METHODS

Assateague Island is a narrow coastal barrier island of approximately 7252 ha located in Worcester County, Maryland and Accomack County, Virginia (Hill 1986). Its northernmost point is at the south end of the Ocean City Inlet, Ocean City, Maryland. The 1621 ha study area was located within Assateague Island National Seashore (38° 10′ N, 75° 10′ W). The study area consisted of tidal marsh (36.1%), shrub swamp (35.7%), loblolly pine (*Pinus taeda*) forest (6.9%), and deciduous forest (1.4%), with some grassland (10.0%) and beach (8.6%) on the eastern side of the island (Churchill 1998). Open water made up the remaining 1.3%. Northern Saw-whet Owl roosting habitat occurred primarily in the shrubland and forested areas with few suitable perches in other areas.

We characterized one Northern Saw-whet Owl day-roost site used by a single owl at Assateague Island in February, 1996 and 29 sites used by four owls from December, 1996 to March, 1997. Roosts were located by radio-tracking owls (Churchill, 1998) fitted with 3 g backpack transmitters (model sopb 2070 mvs from Wildlife Materials Inc., Carbondale, Illinois). Sites were then flagged so they could be relocated and characterized after the owls left. Vegetation and roost site characteristics were measured in a 3 m radius circular plot centered on the roost tree. The following variables were measured: number of stems less than 2.5 cm diameter at breast height (dbh), number of stems 2.5–8 cm dbh, roost tree height, percent canopy cover (3 measurements equally spaced along each quadrant boundary line for a total of 12 measurements within the 3 m plot), a visual estimate of average canopy height and average shrub height, roost tree dbh, distance to nearest tree (>8.0 cm dbh) within 6 m, and an estimate of percent ground cover (shrubs/forbs,

[1] West Virginia Cooperative Fish and Wildlife Research Unit, BRD, USGS and Division of Forestry, West Virginia Univ. PO Box 6125, Morgantown, WV 26506.

[2] Heritage and Biodiversity Programs, Maryland Department of Natural Resources, Annapolis, MD 21401.

[3] Corresponding Author; E-mail: jchurchi@wvu.edu

TABLE 1. Vegetation of Northern Saw-whet Owl roosts on Assateague Island, Maryland, 1996–1997.

Owl ID[a]	Roost site frequency		
	Loblolly pine	Shrub swamp[b]	Other
150.178	4 (4 obs.)[c]	8 (8 obs.)	1 (1 obs.)[d]
150.217	6 (26 obs.)	0	1 (1 obs.)[e]
150.247	8 (8 obs.)	0	1 (2 obs.)[f]
150.338	0	1 (1 obs.)	0
150.188	1 (1 obs.)	0	0
Total	19 (39 obs.)	9 (9 obs.)	3 (4 obs.)

[a] Owl ID represents the frequency of the attached transmitter (in MHZ).
[b] Roosts in wax myrtle (*Myrica cerifera*).
[c] Number of observations (obs.) indicates that owls were observed in the same roosts more than once.
[d] Multiflora rose (*Rosa multiflora*).
[e] Red maple (*Acer rubrum*).
[f] Red cedar (*Juniperus virginiana*; not measured).

leaves, sticks, and other; Churchill 1998). Trees beyond 6 m were assumed to have little or no effect on the immediate roost environment. The same variables were measured at a random site in the same habitat as the roost. The random site was centered around a tree that was located 30 m away in a random direction from the roost. Variables measured at roost sites that did not apply to random sites were roost height, distance perched from trunk, concealment cover above and below the roost, and orientation of the roost branch.

We used Wald's χ^2 statistic from stepwise logistic regression (Hosmer and Lemeshow 1989; entry level = 0.15; stay level = 0.10; PROC LOGISTIC in SAS v. 6.12 for Windows; SAS Institute Inc. 1989) to determine which habitat characteristics differentiated between roost and random sites. The initial model included 12 variables: tree height, canopy cover, average canopy height, average shrub height, roost tree dbh, number of stems less than 2.5 cm, number of stems greater than 2.5 cm, distance to nearest trec, and four categories of ground cover (shrub, leaves, sticks, and other). The "other" category consisted of grass (65%) and water (close to 35%). If no tree occurred within 6 m of the roost tree, a default value of 7 m was used for distance to the nearest tree. Because of small sample sizes, we used Wilcoxon rank sums, a non-parametric statistic that accounts for small sample sizes (Hollander and Wolfe 1973) to compare characteristics of roosts used by owls in pine forest (n = 19) and shrub swamp (n = 9). Roost orientation was calculated for circular distributions after Zar (1999).

RESULTS

Nineteen of 31 roosts were in pine forest (Table 1), although two different roosts used by one owl occurred in the same tree making a total of 30 different roost sites. Roost sites rarely occurred outside of the loblolly pine forest or shrub swamp habitats. Three of the five owls were located at more than one roost.

Five variables distinguished roosts from random sites (Table 2). Roost sites had more large stems (greater than 2.5 cm dbh; Wald's χ^2 = 6.63, 29 df, P = 0.01) and more small stems (less than 2.5 cm dbh; Wald's χ^2 = 4.09, 29 df, P = 0.04) than random sites. Tree diameters were larger at roost sites (Wald's χ^2 = 4.69, 29 df, P = 0.03). Distance to nearest tree was shorter (Wald's χ^2 = 5.97, 29 df, P = 0.02) and average canopy height lower (Wald's χ^2 = 6.42, 29 df, P = 0.01) at roost sites than random sites. Roost orientation was not significant at pine roosts (n = 19, r = 0.39, $P > 0.05$), shrub swamp roosts (n = 9, r = 0.09, $P > 0.05$), or combined roosts (n = 31, r = 0.30, $P < 0.05$).

Roost sites in pine forest and shrub swamp roost sites differed for 10 of the 17 variables we compared (Table 2). Average roost height was significantly lower in shrub swamp areas [1.0 ± 0.2 m (SE)] than in pine forest (4.0 ± 0.8 m; Z = −3.20, 8 df, P = 0.001), possibly because the lower roost tree height in shrub swamp areas (2.9 ± 0.3 m) than in pine forest (7.9 ± 0.7 m; Z = −3.59, 8 df, P = 0.003; Table 2). Number of stems smaller than 2.5 cm averaged higher (289 ± 95) at shrub swamp sites than at pine roost sites (143 ± 54; Z = −2.12, 8 df, P = 0.03; Table 2). Two variables of note that did not differ between pine forest and shrub swamp roosts were concealment cover above (Z = −0.84, 8 df, $P > 0.05$) and below (Z = 0.32, 8 df, $P > 0.05$) the roost.

DISCUSSION

We expected to find Northern Saw-whet Owls roosting in pines on Assateague Island because conifers were often reported as roost trees for Northern Saw-whet Owls (Randle and Austing 1952; Hayward and Garton 1984; Grove 1985; Swengel and Swengel 1987, 1992). Most owls in our study roosted in pines, even though pine woods represented only 6.7% of the study area (Churchill 1998). The use of shrub swamp roost sites on Assateague Island exemplifies the uniqueness of the coastal barrier island as Northern Saw-whet Owl habitat. In our study, 39% of roosts were not in pines. These areas probably would not have been searched if owls had not been detected there

TABLE 2. Characteristics of shrub swamp and pine Northern Saw-whet Owl roosts at Assateague Island, Maryland, 1996–1997.

Variable	Shrub swamp (n = 9)		Pine forest (n = 19)		Combined (n = 28)		Random (n = 28)	
	Mean	Range	Mean	Range	Mean	Range	Mean	Range
Roost height (m)[a]	1.0	(0.5–2.0)	4.0	(0.8–10.7)	2.9	(0.5–10.7)	—	—
Roost orientation (degrees)	166	(0–349)	158	(10–265)	168	(0–349)	—	—
Distance to trunk (cm)	64	(0–290)	152	(0–460)	116	(0–460)	—	—
Roost tree height (m)[a]	2.9	(1.9–4.8)	7.9	(2.0–12.3)	6.1	(1.1–12.3)	6.7	(1.1–14.0)
Above cover (%)	50	(5–85)	50	(10–95)	51	(5–95)	—	—
Below cover (%)	30	(5–65)	20	(5–95)	24	(5–95)	—	—
Canopy cover (%)[a]	0	(0–33)	60	(0–100)	39	(0–100)	41	(0–92)
Average canopy height (m)[a,b]	2.4	(0–7.6)	7.6	(0–11.1)	6.1	(0–11.1)	7.0	(0–14)
Average shrub height (cm)[a]	305	(200–396)	217	(100–300)	247	(100–396)	244	(60–460)
Roost tree dbh (cm)[a,b]	4	(2–7)	25	(3–45)	18	(2–45)	16	(1–42)
Nearest tree (m)[a,b]	6.2	(3.3–7.0)	3.6	(2.0–7.0)	4.4	(2.0–7.0)	4.7	(1.8–7.0)
Number of stems <2.5 cm dbh[a,b]	289	(56–847)	143	(2–978)	183	(2–978)	58	(0–254)
Number of stems >2.5 cm dbh[b]	7	(0–18)	3	(0–15)	5	(0–18)	2	(0–11)
Ground cover (%)								
Shrub/forbs	0	(0–24)	10	(0–34)	7	(0–34)	5	(0–16)
Leaves/pine needles	50	(0–100)	80	(20–98)	64	(0–100)	57	(0–91)
Sticks[a]	0	(0–9)	10	(0–18)	6	(0–18)	7	(0–28)
Other[a,c]	50	(0–93)	10	(0–80)	25	(0–93)	32	(0–95)

[a] Pine and shrub swamp roost sites were significantly different at $P \leq 0.05$ using Wilcoxon rank sum tests for small sample size.
[b] Roost and random sites were significantly different at $P \leq 0.05$ using Logistic Regression.
[c] The "other" category of ground cover consisted of water, sand, and grass.

via telemetry because they often occurred where thick vegetation hindered accessibility. Consequently, other methods of locating owls (and subsequent roost site characterization) such as visual detection of roost sites, could be biased by the relative ease of locating roosts in conifers. Only three of five published roost site studies (Randle and Austing 1952, Hayward and Garton 1984, Grove 1985) described roosts in trees other than pines and in each case, such roosts were uncommon.

Average roost tree height and diameter were much greater in Idaho (Hayward and Garton 1984) while average roost tree height in Wisconsin (Swengel and Swengel 1992) was slightly greater than at Assateague Island (Table 3). The shorter roost trees in Maryland may be due to several factors including stunted growth of loblolly pines caused by the harsh coastal environment, species differences between the loblolly pines at Assateague Island and pine species found in Wisconsin and Idaho, or the lack of roosts other than pines in other studies. The range in height of the roost itself was relatively similar in all studies except ours (Table 3). Roost height may be influenced by the risk of predation as has been suggested for Eastern Screech-Owls (*Otus asio;* Duguay et al. 1997).

In several studies, including ours, owls often roosted far from the trunk (Table 3). This distal positioning on the branch is possible for a small lightweight owl, whereas the ends of the branch would not support a larger, heavier bird. Grove (1985:23) described Northern Saw-whet Owl roosts as being far from the main trunk "where cover density was greatest".

Because Northern Saw-whet Owl roost sites have been documented in a variety of habitats, roosts in shrub swamp areas were not unexpected. Pine forest may be preferred over shrub swamp, but our results suggest owls roost wherever cover is dense. Northern Saw-

TABLE 3. A comparison of Northern Saw-whet Owl roost site characteristics.

Characteristics	Idaho[a] (3 owls) (range, *n* roosts)	Ohio[b] (NA owls)[h] (range, *n* roosts)	Maryland[c] (5 owls) (range, *n* roosts)	Washington[d] (NA owls) (range, *n* roosts)	Wisconsin[e] (NA owls) (range, *n* roosts)	Wisconsin[f] (NA owls) (range, *n* roosts)
Roost tree height	22.6 ± 3.04 m (—, 15)	—[h]	6.1 ± 3.5 m (1.1–12.3 m, 30)	—	—	9.2 ± 3.4 (1.5–22 m, 591)
Roost tree dbh	46.0 ± 8.2 m (—, 15)	—	17.4 ± 13.4 cm (2.0–45.0 cm, 30)	—	—	15.9 ± 6.3 cm (1–48 cm, 472)
Perch height	4.2 ± 0.6 m (0.9–7.3 m, 15)	usually 2.4–3.0 m (max 5.5 m, 15)	2.9 ± 3.0 m (0.5–10.7 m, 30)	— (0.7–7.7 m, 90)	— (0.69–7.67 m, 90)	4.1 ± 2.2 m (0.15–11.2 m, 429)
Perch distance	—	— (50–75% BL,[g] 15)	119.7 ± 132.6 cm (0–460.0 cm, 30)	— (30–183 cm, 8)	—	30.9 ± 22.2% BL (1.3–100% BL, 372)

[a] Hayward and Garton 1984.
[b] Randle and Austing 1952.
[c] Churchill 1998.
[d] Grove 1985.
[e] Swengel and Swengel 1987.
[f] Swengel and Swengel 1992.
[g] BL = branch length.
[h] Information not available.

whet Owls roosted in areas with high stem densities. Roost sites with the highest stem densities often were in wax myrtles within shrub swamps where the stems were predominantly common reeds (*Phragmites australis*) over 2 m tall. Roost sites in pine forests often had high densities of greenbriar (*Smilax* spp.). The greenbriar was so dense at one red cedar *(Juniperus virginiana)* roost, we could not measure the roost characteristics. Judging by our difficulty of finding some of these roosts from the ground, common reeds and greenbriar may provide excellent cover from terrestrial predators. Concealment cover above roosts was the same (50%) for both shrub swamp and pine forest roosts suggesting that owls key in on cover in roost selection rather than selecting for specific plant species.

ACKNOWLEDGMENTS

Primary funding for this research came from the Maryland Ornithological Society with additional contributions (logistical, equipment, in kind support) from The West Virginia Cooperative Fish and Wildlife Research Unit, BRD, USGS at West Virginia University, Assateague Island National Seashore and The Maryland Department of Natural Resources. We thank J. P. Duguay, M. P. Rowe, J. L. Savard, G. E. Williams, and two anonymous reviewers for helpful comments on this manuscript. This is Scientific Article #2752 of the West Virginia University Agriculture and Forestry Experiment Station.

LITERATURE CITED

CHURCHILL, J. B. 1998. Winter movements and habitat use of Northern Saw-whet Owls at Assateague Island, Maryland. M.S. thesis, West Virginia Univ., Morgantown.

DUGUAY, T. A., G. RITCHISON, AND J. P. DUGUAY. 1997. The winter roosting behavior of Eastern Screech-Owls in central Kentucky. J. Raptor Res. 31:260–266.

GROVE, R. A. 1985. Northern Saw-whet Owl winter food and roosting habits in north-central Washington. Murrelet 66:21–24.

HAYWARD, G. D. AND E. O. GARTON. 1984. Roost habitat selection by three small forest owls. Wilson Bull. 96:690–692.

HILL, S. R. 1986. An annotated checklist of the vascular flora of Assateague Island (Maryland and Virginia). Castanea 51:265–305.

HOLLANDER, M. AND D. A. WOLFE. 1973. Nonparametric statistical methods. John Wiley and Sons, New York.

HOSMER, D. W. AND S. LEMESHOW. 1989. Applied logistic regression. John Wiley and Sons, New York.

LOOS, G. AND P. KERLINGER. 1993. Road mortality of

saw-whet and screech-owls on the Cape May peninsula. J. Raptor Res. 27:210–213.

RANDLE, W. AND R. AUSTING. 1952. Ecological notes on Long-eared and Saw-whet owls in southwestern Ohio. Ecology 33:422–426.

SAS INSTITUTE INC. 1989. SAS/STAT user's guide. Release 6.12 ed. SAS Institute, Cary, North Carolina.

SWENGEL, S. R. AND A. B. SWENGEL. 1987. Study of a Northern Saw-whet Owl population in Sauk County, Wisconsin. U.S. For. Serv. Gen. Tech. Rep. RM-142:199–208.

SWENGEL, S. R. AND A. B. SWENGEL. 1992. Roosts of Northern Saw-whet Owls in southern Wisconsin. Condor 94:699–706.

ZAR, J. H. 1999. Biostatistical analysis, fourth ed. Prentice-Hall, Englewood Cliffs, New Jersey.